MotionVision®

CA-D6-xxxxW

High-Speed Area Scan Cameras

Camera User's Manual

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rev 06

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DALSA
CCD Image Capture Technology

CA-D6-xxxxW Camera User's Manual **Document Number 03-32-00225**

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About DALSA

DALSA specializes in the manufacture, design, research and development of high performance solid state CCD image sensors and modular cameras. DALSA cameras provide the highest spatial resolution at the highest data transfer speed of any known products in the industry. DALSA's CCD image sensors and cameras are used worldwide in document scanning, image capture, surveillance, process monitoring and manufacturing inspection. DALSA also develops customized products for specific customers and applications.

All DALSA products are manufactured using the latest state-of-the-art equipment to ensure product reliability. All electronic modules and cameras are subjected to a 24 hour burn-in test.

For further information not included in this manual, or for information on DALSA's extensive line of image sensing products, please call:

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™ Our symbol represents a cross-section of the control circuitry basic to all DALSA image sensors.

CA-D6-xxxxW User's Manual

Contents

CHAPTER 1

1.0 Introduction to the CA-D6

1.1 Camera Highlights

- 260x260 or 532Hx516V pixels, 10 µm square with 100% fill factor
- Frame transfer architecture and pixel reset—no shutter required
- 4 outputs at 25 MHz: frame rates to 955 or 262 frames/sec
- 8 bit digital data in EIA-644 (LVDS differential) format
- Separate connectors for power, control and data
- "Snapshot" operation
- Vertical antiblooming
- Operation verified to limits set in EMC standards IEC 1000-4-2; 1995, 1000-4-3; 1995, 1000-4-4; 1995, and CISPR-22.

The CA-D6-xxxxW cameras use DALSA's patented modular architecture. This system of connecting circuit modules through standardized busses allows DALSA to build a high performance modular camera using the reliability, flexibility, and cost-effectiveness of high-volume interchangeable parts. Within the camera, a timing board (PB-D6-X205) generates all internal timing and a driver board (PB-D6-A198) provides bias voltages and clocks to the CCD image sensor. Two A/D boards (PB-xxD344) process the video and an output board (PB-xx-X733) filters the power lines.

1.2 Image Sensor

The CA-D6-xxxxW use the IA-D6 family of image sensors. Available in 260x260 and 532x516 arrays, the sensors have 10 µm square pixels with 100% fill factor. The IA-D6 image sensors use a frame transfer architecture, providing on-chip storage.

Figure 1. IA-D6-0256 Image Sensor

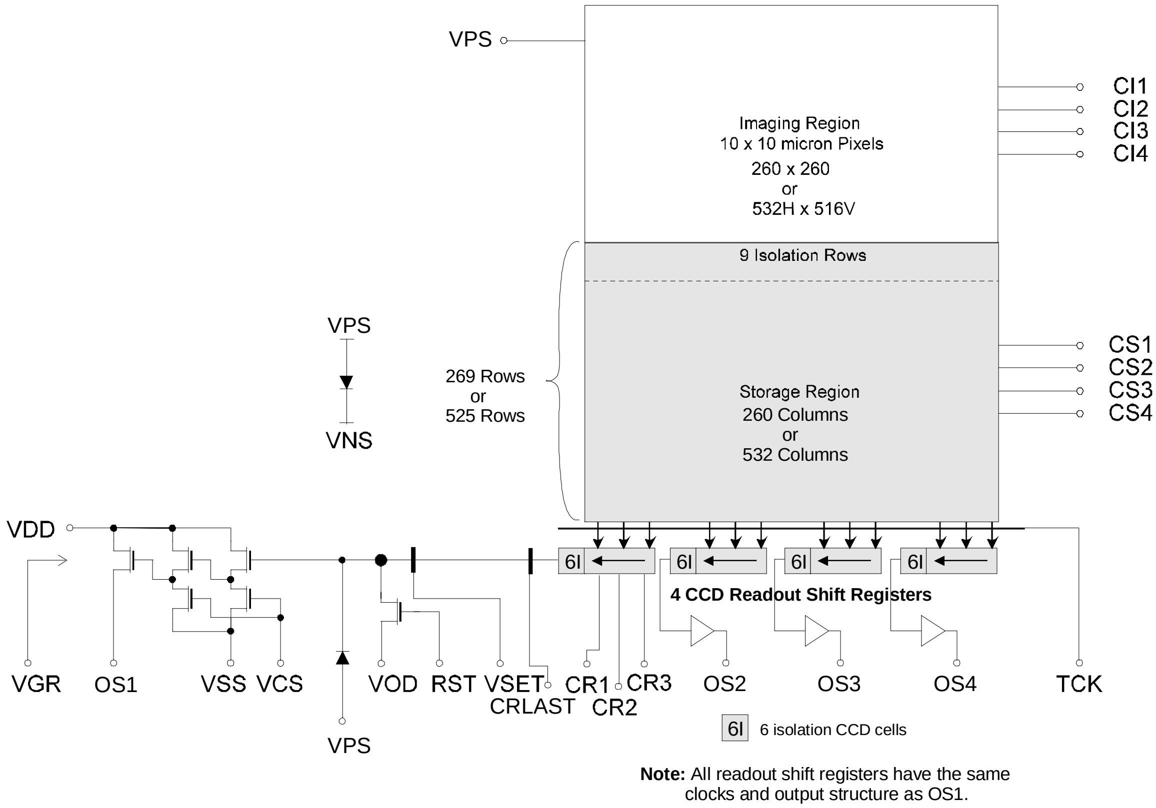
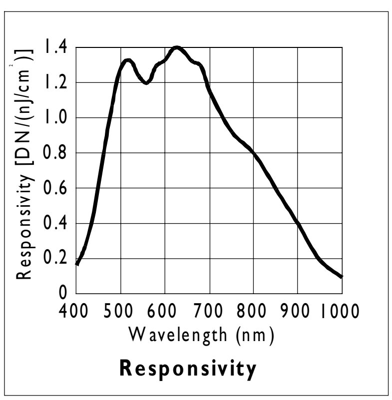


Figure 2. CA-D6 Camera Spectral Response



1.3 Camera Performance Specifications

Table 1. CA-D6-xxxxW Performance Specifications

Calibration Conditions	Units	Min.	Typ.	Max.	*Notes*
Frame Rate (FVAL)	Hz				
256x256	Hz			955	
512x512	Hz			262	
Data Rate (STROBE)	MHz		25		
Halogen light source					*1*
Specification	**Units**	**Min.**	**Typ.**	**Max.**	***Notes***
Saturation Output Amplitude	DN	243	248	254	
Photoresponse Non-Uniformity (PRNU)	DN (rms)		1.2	1.8	*2*
PRNU with exposure control	DN (rms)		1.6	2.4	*2*
Fixed Pattern Noise (FPN)	DN (rms)		0.5	0.75	*3*
Output Gain Mismatch	DN		1.5	3.0	
Mean Output Offset	DN	4	5	8	
Random Noise	DN (rms)		0.45	0.75	
Noise Equivalent Exposure	pJ/cm^2		336		
Saturation Equivalent Exposure	nJ/cm^2		181.4		
Responsivity	$DN/(nJ/cm^2)$		1.34		*1*
Dynamic Range	ratio	325:1	540:1		
Supply Current (256/512)					
+15.0 V	mA		300/350	350/400	
+5.0 V	mA		900/1200	950/1300	*4*
+5.0 V	mA		1000/1300	1050/1400	*5*
-5.0 V	mA		200/230	250/280	
Operating Temperature	°C	0		50	

Notes

DN = digital numbers, also known as "levels" (0-255 for 8-bit systems).
All cameras use sensor grade 01. Other grades also available. Contact DALSA for information.

1. DC light source, bulb color temp 3150K, 750nm cutoff filter.
2. Measured at 20%, 50% and 80% of VSAT.
3. Measured at 50% of VSAT.
4. Unterminated outputs.
5. Terminated outputs.

Table 2. IA-D6 Sensor Cosmetic Specifications

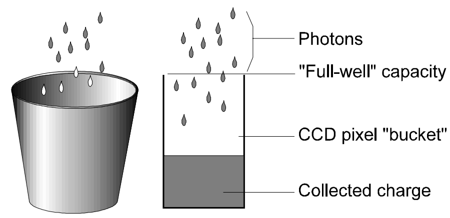
	Specification	IA-D6 Grade
		01
a	Number of first & last columns excluded	1
b	Number of first & last rows excluded	1
c	Max. # of single pixel blemishes	10
d	Max. # of cluster blemishes	0
e	Max. size of clusters (# of adjacent pixels)	NA
f	Max. # of column defects	0
g	Blemish variation from mean at 50% VSAT	±10%
h	Blemish variation from average dark level (DN)	5

1.4 CCD Camera Primer

How CCD Image Sensors Work

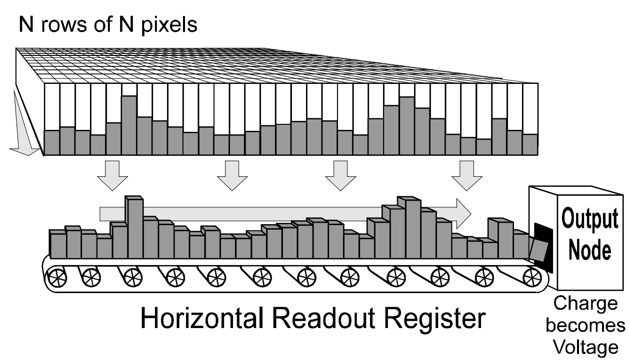
In a CCD camera such as the CA-D6-xxxxW, a CCD image sensor converts photons (light) into electrons (electricity). When photons hit an image sensor, an electron is released, and the sensor adds this electric charge to the charge it has already collected. This is called charge integration. The brighter your light source, the more photons available for the sensor to integrate, and the smaller the amount of time required to collect a given amount of charge.

The way photosensitive elements (pixels) on CCD image sensors collect charge has often been compared to buckets filling with water. From this analogy comes the term "full-well capacity," meaning the maximum charge (number of electrons) a pixel can hold without "spilling" charge onto adjacent pixels.



As light energy hits an array of pixels, the pixels collect charge. At certain intervals, a frame transfer sensor such as the IA-D6 transfers its collected charge from the active, photosensitive region to a light-shielded storage region. Then it transfers the charge, line by line, to one or more readout registers, which feed each pixel's charge from the image sensor into an output node that converts the charges into voltages.

After this transfer and conversion, the voltages are amplified to become the camera's analog output. In digital output cameras, the camera's analog-to-digital (A / D) board converts voltages to digital numbers (0-255 for 8-bit cameras). These digital numbers are what the camera outputs as data to a framegrabber.



For more information on terms and concepts from the digital imaging industry, see DALSA's current Databook Glossary, CCD Technology Primer, and Application Notes.

CHAPTER 2

2.0 Camera Hardware Interface

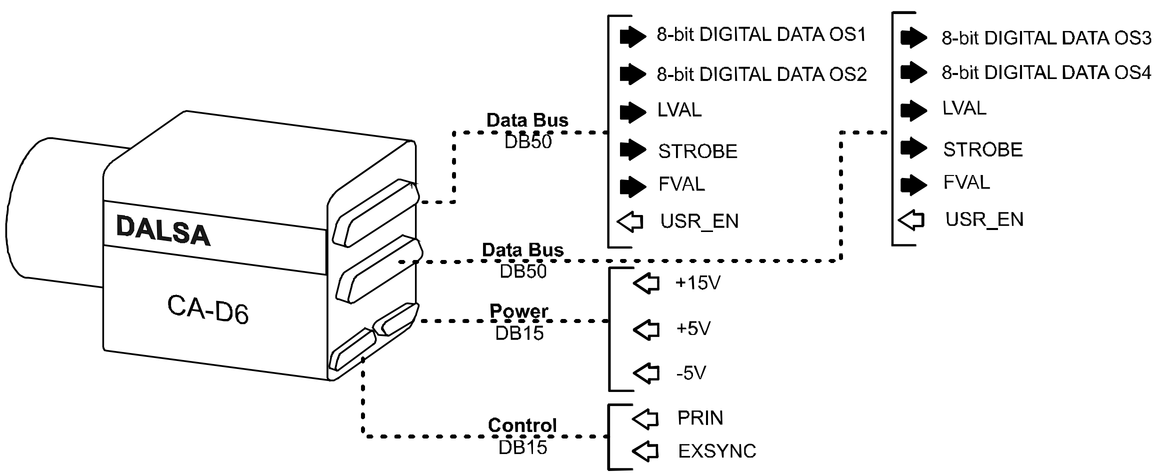
2.1 Installation Overview

In order to set up your camera, you should take these steps:

1. Decide on modes of operation—will you use USR_EN?
2. Test and connect power supplies.
3. Test and connect User Bus control signals from framegrabber.
4. Test and connect data signals output from camera.

You must also set up the other components of your system, including light sources, framegrabbers, camera mounts, heat sinks, host computers, optics, and so on.

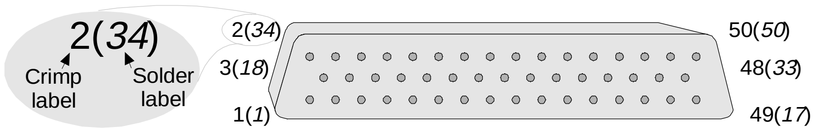
2.2 Input/Output



2.3 Connectors, Pinouts, and Cables

DB50F—Data Bus—OS1/OS2 and OS3/OS4

Camera connector uses crimp labeling convention for pin numbers

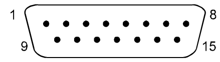


Mating Part: Amphenol 17D-D50P (solder pin) with shell 17-1657-50
Cable: 26 AWG 100Ω shielded twisted pair

Note on DB50 connectors: There are several standard ways to number the pins of DB50 connectors. The connectors on the back of the camera use the “crimp” convention, but many shielded connectors used to control EMI/EMC (including the Amphenol part listed here) use the “solder” convention. To help you translate between numbering conventions, this pinout table lists both. The signals are located on the same physical pins in both cases, but the STROBE pin is numbered 37 under the “crimp” convention and 13 under the “solder” convention.

Crimp Label	Solder Label	Signal	Crimp Label	Solder Label	Signal	Crimp Label	Solder Label	Signal
1	1	OSBD7	3	18	OS2D6	2	34	OS2D7B
4	2	OS2D6B	6	19	OS2D5B	5	35	OS2D5
7	3	OS2D4	9	20	OS2D3	8	36	OS2D4B
10	4	OS2D3B	12	21	OS2D2B	11	37	OS2D2
13	5	OS2D1	15	22	OS2D0	14	38	OS2D1B
16	6	OS2D0B	18	23	FVALB	17	39	FVAL
19	7	USR_EN	21	24	OS1D7	20	40	USR_ENB
22	8	OS1D7B	24	25	OS1D6B	23	41	OS1D6
25	9	OS1D5	27	26	OS1D4	26	42	OSID5B
28	10	OS1D4B	30	27	OS1D3B	29	43	OS1D3
31	11	OS1D2	33	28	OS1D1	32	44	OS1D2B
34	12	OS1D1B	36	29	OS1D0B	35	45	OS1D0
37	13	STROBE	39	30	LVAL	38	46	STROBEB
40	14	LVALB	42	31	not used	41	47	not used
43	15	not used	45	32	not used	44	48	not used
46	16	not used	48	33	not used	47	49	not used
49	17	not used				50	50	not used

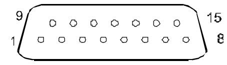
DB15M—Power



Mating Part: Amphenol 17D-A15S
with shell 17-1657-15
Cable: 22 AWG min. shielded

Pin	Signal	Pin	Signal
1	DGND	9	+5V Digital
2	+5V Digital	10	DGND
3	not used	11	not used
4	-5V Digital	12	not used
5	Not used	13	-5V Analog
6	+15V	14	AGND
7	+15V	15	+5V Analog
8	AGND		

DB15F—Control



Mating Part: Amphenol 17D-A15P
with shell 17-1657-15
Cable: 22 AWG min. shielded

Pin	Signal	Pin	Signal
1	not used	9	not used
2	not used	10	not used
3	not used	11	not used
4	EXSYNCB	12	EXSYNC
5	PRIN	13	PRINB
6	future use	14	future use
7	not used	15	not used
8	not used		

2.4 Power Supplies

See section 1.3 for power requirements.

When setting up the camera's power supplies, follow these guidelines:

- Do not use the shield on a multi-conductor cable for ground.
- Connect separate supplies at the source and at the camera.
- Use separate leads for better noise immunity.

The companies listed below make power supplies that meet the camera's requirements, but they should not be considered the only choices. Many high quality supplies are available from other vendors. DALSA assumes no responsibility for the use of these supplies.

- Uniforce, 408-946-3864 (CA, USA)
- Vision 1, 406-585-7225 (MT, USA)
- Xantrex, 206-671-2966 (WA, USA)
- Power-One, 805-987-8741 (CA, USA)
- Tectrol Inc., 416-630-4026 (ON, CAN)

2.5 User Bus (Inputs)

The User Bus uses a DB25 connector and includes the mandatory control signal EXSYNC and optional signal PRIN. These signals must be supplied from your framegrabber to the camera using EIA-644 (differential) format, which requires the use of twisted pair cable. DALSA recommends shielded cables. Maximum cable lengths depends on environmental factors and EIA-644 limitations. See Appendix A.

EXSYNC—Triggers Frame Readout

EXSYNC is an optional signal used to control the camera's frame rate. When EXSYNC is left unconnected or connected to logic LOW, the camera outputs data at its maximum frame rate (free-run mode). When EXSYNC is toggled, its falling edge triggers frame readout; in this mode its frequency determines the camera's frame rate (FVAL frequency). The delay between the falling edge of EXSYNC and the first valid pixel varies with model and is shown on the timing diagram (section 2.9).

Minimum EXSYNC high or low time: 100 ns.
• DB15 Pins—EXSYNC: 12; EXSYNCB: 4.

Note: Restricting EXSYNC to logic HIGH prevents frame readout.

PRIN—Controls Electronic Shuttering

PRIN is an optional signal that can shorten the effective exposure time by resetting the pixels (draining accumulated charge) on the image sensor between EXSYNC-triggered frame readouts. PRIN is active when connected to logic LOW; exposure effectively begins on the rising edge of PRIN. If PRIN is unconnected or connected to logic HIGH, the integration time is maximized; if it is connected to logic LOW the sensor collects no image information. The PRIN pulse width must be 6.5±1µs. During the frame transfer period, the camera ignores PRIN inputs.
• DB15 pins: PRIN 5; PRINB 13.

Application Tip: Combining Input Signals for Exposure Control and "Snapshot" Operation

When used together, EXSYNC and PRIN can give very precise control over exposure and image capture. The examples below illustrate some camera operating options.

Figure 3 depicts the operation of the camera when EXSYNC is kept low and PRIN high at all times. The camera operates at its maximum frame rate with the maximum exposure time, which is defined as the time from the end of one frame transport to the beginning of the next frame transport.

Figure 3. Free-Run Mode

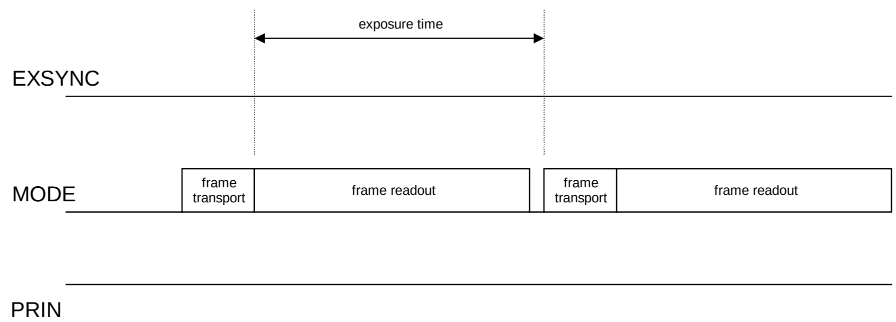


Figure 4 depicts the operation of the camera when the EXSYNC signal frequency is user controlled. The frame rate is variable and depends solely on the EXSYNC rate. Keeping PRIN high maximizes the time the sensor is exposed to light. The exposure time is defined from the end of one frame transport to the beginning of the next frame transport.

Figure 4. User-Controlled EXSYNC

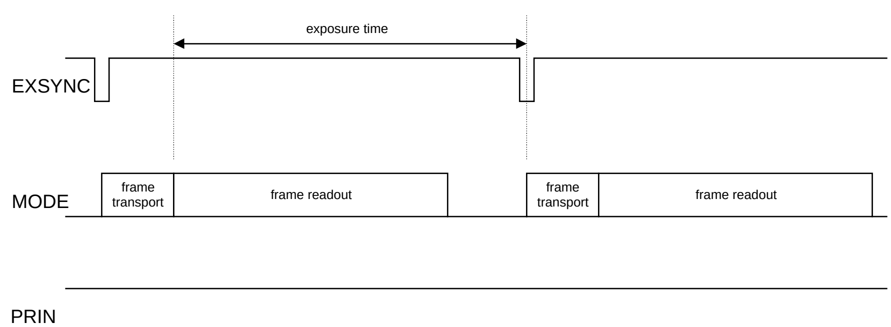
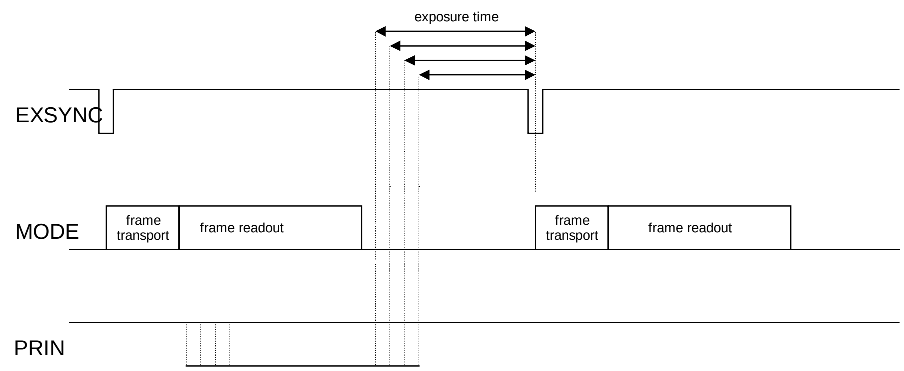


Figure 5 shows the operation of the camera when EXSYNC and PRIN are both user controlled. The start of the exposure time depends on the rising edge of PRIN in combination with the falling edge of EXSYNC. The exposure time is defined from the rising edge of PRIN to the falling edge of EXSYNC. PRIN must be kept low for 6.5±1µs to drain all charge that was previously collected. Note also that the camera will ignore PRIN inputs during frame readout.

Figure 5. User-Controlled EXSYNC and PRIN

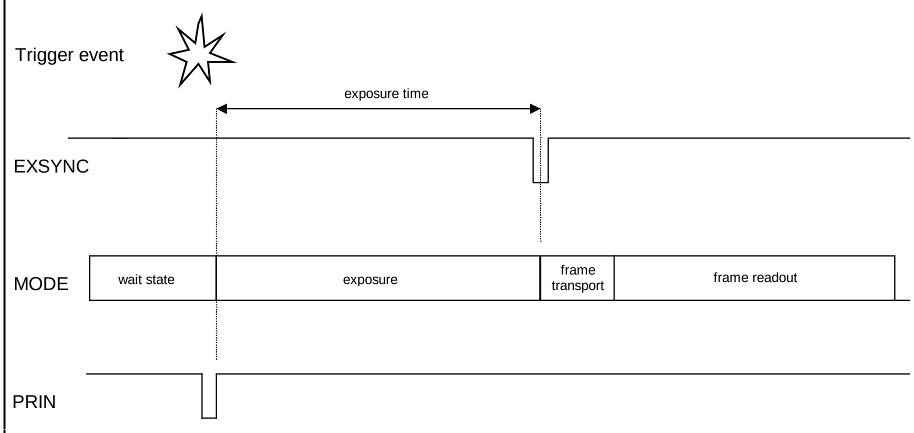


For "snapshot" operation (see Figure 6), you can use a combination of EXSYNC and PRIN to trigger image capture from external event. The CA-D6 can remain in a wait state until it receives a combination of EXSYNC and PRIN.

During the wait state, the EXSYNC and PRIN signals must be high (meaning the camera is continually integrating incident light). To begin the effective exposure period, PRIN must be toggle low for 6.5±1µs and then high. After the desired exposure (e.g. 20 ms) EXSYNC must go low, and the exposed frame is transferred and output.

cont'd...

Figure 6. Event-Triggered Image Capture



Note that to have the camera react to an external event, your imaging system must detect the event and then send the appropriate EXSYNC and PRIN signals to the camera to cause it to capture images.

2.6 Data Bus

See section 2.3 for pinouts.

Digital Data

The CA-D6-xxxxW provides 4 channels of 8 bits of data in EIA-644 differential format at 25 MHz.

To help clock digital data into framegrabbers, the camera outputs clocking signals STROBE, LVAL, and FVAL.

IMPORTANT: This camera's data is valid on the ***rising*** edge of STROBE, unlike previous DALSA cameras, which used the falling edge.

STROBE

STROBE is a pixel clock signal for digital data. It is continuous, toggling even when data is not valid. Digital data is valid on its **rising edge** with LVAL and FVAL high.

LVAL

LVAL high with FVAL high indicates the camera is outputting a valid line of pixels. Between valid lines within a frame, LVAL goes low for 29 inactive pixels (0256 model) or 47 inactive pixels (0512 model).

FVAL

FVAL high indicates the camera is outputting a valid frame of data.

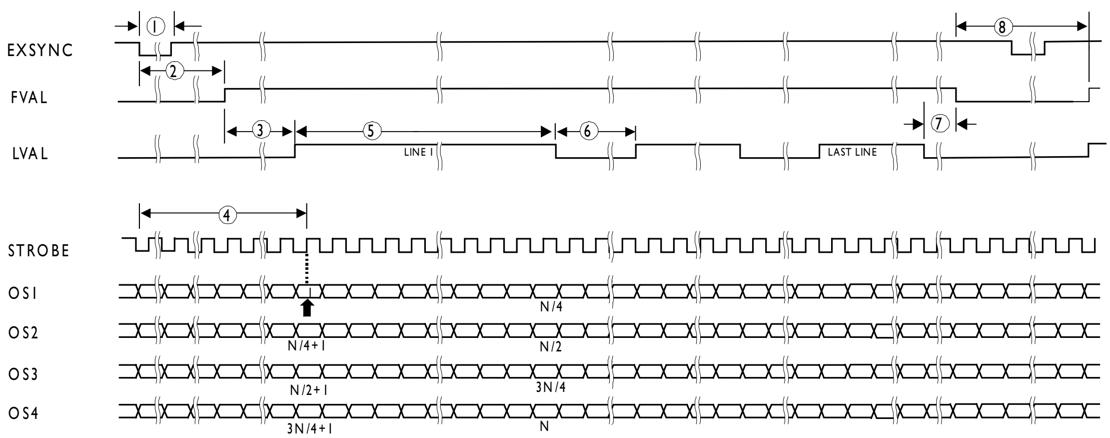
USR_EN—Input for Multiplexing

USR_EN is an input used during camera multiplexing. When multiple cameras share the same data bus, their digital data outputs can be placed into tri-state by connecting USR_EN to logic LOW. Connecting USR_EN to logic HIGH activates a camera's outputs. USR_EN is an optional signal; if not using USR_EN, connect it to logic HIGH and USR_ENB to logic LOW.

2.7 Timing

When exposed to light, the sensor collects charge. The EXSYNC control signal (input from framegrabber) triggers the transfer and readout of the charge. The FVAL output goes high to indicate a valid frame; the LVAL output goes high for each of the lines that make up the frame. LVAL goes low between the lines of a frame. The STROBE signal is a pixel clock; digital data is valid on its **rising edge**. After a frame is read out, the FVAL signal goes low and the sensor collects charge for the next frame.

Figure 7. CA-D6-xxxxW Overall Timing



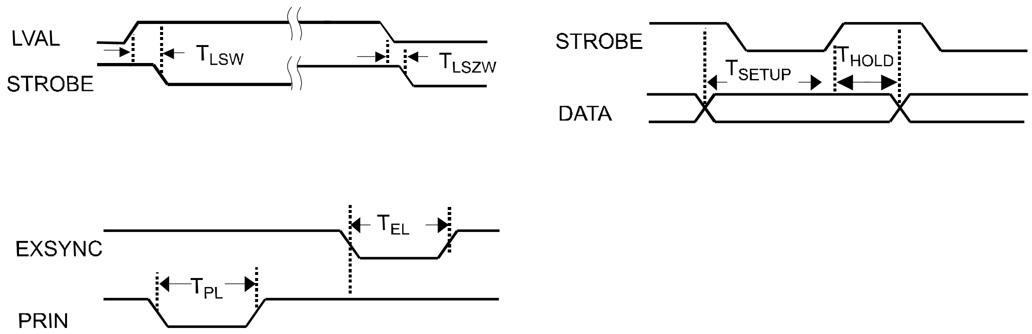
NOTES:

⬆ Position of the first valid pixel (valid on the **rising edge** of STROBE)

	0256	**0512**
Dimensions of single frame	4x(260 lines of 65 pixels)	4x(516 lines of 133 pixels)
1 EXSYNC minimum pulse width	100ns	100ns
2 EXSYNC to ↑FVAL	1542 STROBEs	7136 STROBEs
3 FVAL to ↑LVAL	22 STROBEs	22 STROBEs
4 EXSYNC to first valid pixel	1564 STROBEs	7158 STROBEs
5 LVAL HIGH	65 STROBEs	133 STROBEs
6 Between lines: LVAL LOW	29 STROBEs	37 STROBEs
7 ↓LVAL to ↓FVAL	15 STROBEs	15 STROBEs
8 Minimum time between frames	1715 STROBEs	7461 STROBEs

IMPORTANT:
This camera's data is valid on the ***rising*** edge of STROBE, unlike previous DALSA cameras, which used the falling edge.

Figure 8. CA-D6-xxxxW Detailed Timing

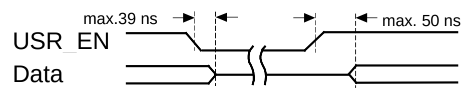


Symbol	Description	Min.	Typ.	Max.	Unit
T_{LSW}	↑LVAL to ↓STROBE	-2	0	2	ns
T_{LSZW}	↓LVAL to ↓STROBE	-2	0	2	ns
T_{SETUP}	Data setup	18	23	28	ns
T_{HOLD}	Data hold	12	17	22	ns
T_{PL}	PRIN pulse	5.5	6.5	7.5	µs
T_{EL}	EXSYNC pulse	100			ns

2.8 Multi-Camera Operation

Camera Multiplexing

Camera multiplexing puts multiple cameras on the same data bus. All the multiplexed cameras are spliced into the same data cable; this is possible because the camera's output line drivers can be tri-stated. The usual control signals can be spliced on a single cable, but they can also be kept separate for each camera. The cameras do not require synchronized control signals because only one camera can be active at any one time—a camera becomes active when you supply it with a differential USR_EN signal. Each multiplexed camera ***must*** receive its own USR_EN signal from a separate differential pair from a EIA-644 line driver.



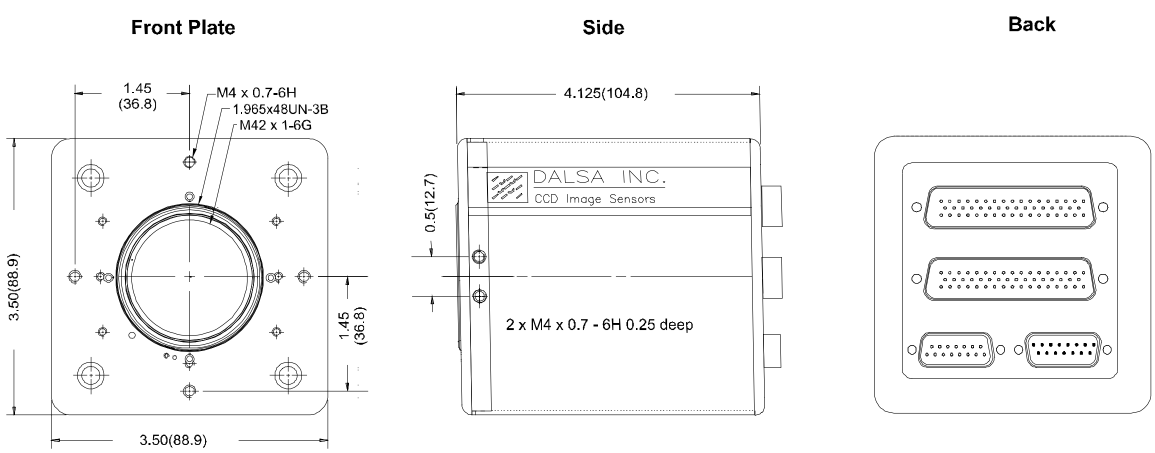
USR_EN in logic HIGH activates camera output. USR_EN in logic LOW puts outputs in tri-state. Note that toggling the camera outputs from tri-state to active requires a small but important amount of setup and hold time. Be sure to take this time into account when configuring your system.

CHAPTER 3

3.0 Optical and Mechanical Considerations

3.1 Mechanical Interface

The camera’s electronics are housed in a rugged anodized aluminum case.



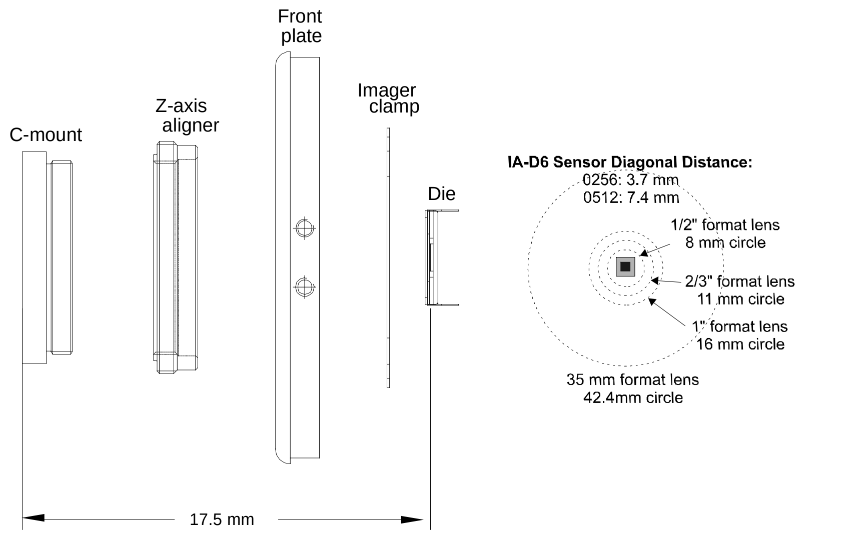
Mounting

For maximum stability and best heat sinking, DALSA recommends mounting the camera by its front plate. There are four M4 holes and seven 4-40 UNC holes tapped into the front plate for mounting the camera or attaching heat sinking. Other mounting options include M4 holes on the sides of the camera (stability increases with number of sides used) and the tripod mount (least stable).

Environment

The camera and cables should be shielded from environmental noise sources for best operation. The camera should also be kept as cool as possible. Mounting holes (see above) allow you to attach heat sinking.

3.2 Optical Interface



Note: Exploded view

The CA-D6-xxxxW camera comes with a mount adapter for C-mount lenses, which have a back focal distance of 17.5 mm. Ensure that the image circle diameter of the lens to be used is as great as the diagonal of the imaging region of the image sensor.

IMPORTANT: The camera’s Z-axis alignment is optimized for the adapter provided. Do not remove the mount adapter without contacting DALSA first, or you may misalign your lens.

Illumination

The amount and wavelengths of light required to capture useful images depend on the particular application. Factors include the nature, speed, and spectral characteristics of objects being imaged, exposure times, light source characteristics, environmental and acquisition system specifics, and more. DALSA’s current Databook provides an introduction to this potentially complicated issue. See “4.Radiometry and Photo Responsivity” and “Camera Sensitivities in Photometric Units”.

It is often more important to consider exposure than illumination. The total amount of energy (which is related to the total number of photons reaching the sensor) is more important than the rate at which it arrives. For example, 5 $\mu J/cm^2$ can be achieved by exposing 5 mW/cm^2 for 1 mS just the same as exposing an intensity of 5 W/cm^2 for 1 μS.

Light Sources

Keep these guidelines in mind when setting up your light source.

- Halogen light sources generally provide very little blue relative to IR.
- Fiber-optic light distribution systems generally transmit very little blue relative to IR.
- Some light sources age; over their lifespan they produce less light. This aging may not be uniform—a light source may produce progressively less light in some areas of the spectrum but not others.

Filters

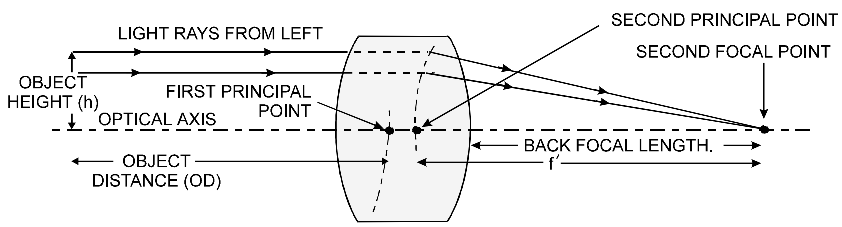
CCD cameras are often very responsive to infrared (IR) wavelengths of light. If you wish to exclude IR, use a "hot mirror" or IR cutoff filter that transmits visible wavelengths but does not transmit wavelengths over 700 µm. Examples are the Schneider Optics™ B+W 489, which includes a mounting ring, the CORION™ LS-750, which does not include a mounting ring, and the CORION™ HR-750 series hot mirror.

Lens Modeling

Any lens surrounded by air can be modeled for camera purposes using three primary points: the first and second principal points and the second focal point. The primary points for a lens should be available from the lens data sheet or from the lens manufacturer. Primed quantities denote characteristics of the image side of the lens. That is, *h* is the object height and *h′* is the image height.

The *focal point* is the point at which the image of an infinitely distant object is brought to focus. The *effective focal length (f′)* is the distance from the second principal point to the second focal point. The *back focal length (BFL)* is the distance from the image side of the lens surface to the second focal point. The *object distance (OD)* is the distance from the first principal point to the object.

Figure 9. Primary Points in a Lens System



Magnification and Resolution

The magnification of a lens is the ratio of the image size to the object size:

$$m = \frac{h'}{h}$$

where m is the magnification, h' is the image height (pixel size) and h is the object height (desired object resolution size).

By similar triangles, the magnification is alternatively given by:

$$m = \frac{f'}{OD}$$

These equations can be combined to give their most useful form:

$$\frac{h'}{h} = \frac{f'}{OD}$$

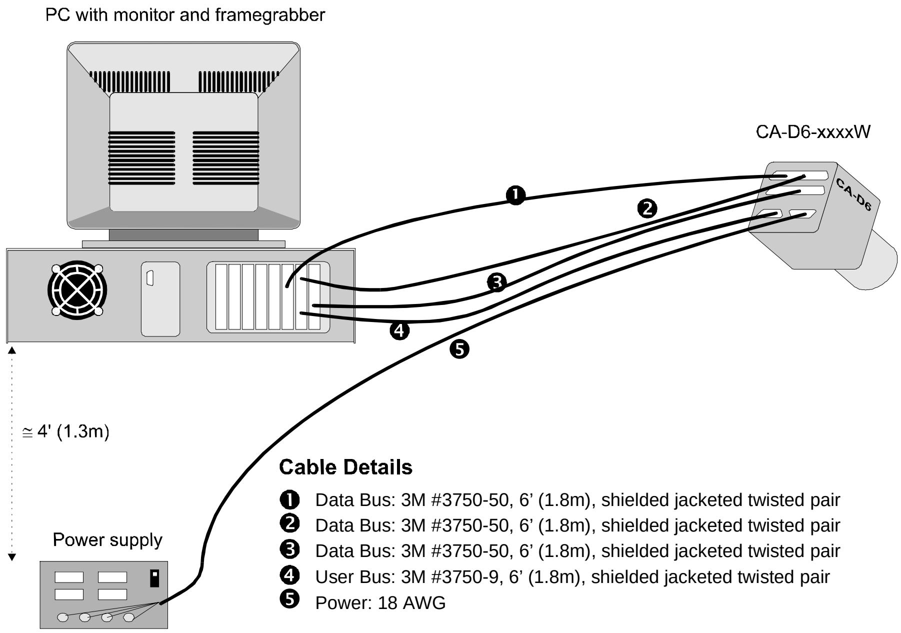
This is the governing equation for many object and image plane parameters.

Example: An acquisition system has a 512 x 512 element, 10 µm pixel pitch area scan camera, a lens with an effective focal length of 45 mm, and requires that 100µm in the object space correspond to each pixel in the image sensor. Using the preceding equation, the object distance must be 450 mm (0.450 m).

$$\frac{10\mu m}{100\mu m} = \frac{45mm}{OD} \qquad OD = 450mm\,(0.450m)$$

3.3 EMC Operation

The CA-D6 has been designed for EMC compliance. The test setup shown below has been verified to the limits set in EMC standards IEC 1000-4-2; 1995, 1000-4-3; 1995, 1000-4-4; 1995, and CISPR-22.



Follow these specific guidelines to maximize compliance in your application:

- Keep control and data cables as short as possible.
- Control and data cables must have 95% coverage shields that include braided wire. Metallic foil shields are insufficient without braided wire.
- Ensure that all cable shields have 360° electrical connection to the connector.

CHAPTER 4

4.0 Troubleshooting

The information in this chapter can help you solve problems that may occur during the setup of your camera. Remember that the camera is part of the entire acquisition system. You may have to troubleshoot any or all of the following:

- power supplies
- framegrabber hardware & software
- light sources
- operating environment
- cabling
- host computer
- optics
- encoder

Your steps in dealing with a technical problem should be:

1. Follow the troubleshooting flowchart (Figure 10 in this chapter).
2. Try the general and specific solutions listed in sections 4.1 and 4.2.
3. If these solutions do not resolve your problem, see section 4.3 on getting product support.

4.1 Common Solutions

Connections

The first step in troubleshooting is to verify that your camera has all the correct connections. Follow the troubleshooting flowchart shown in Figure 10.

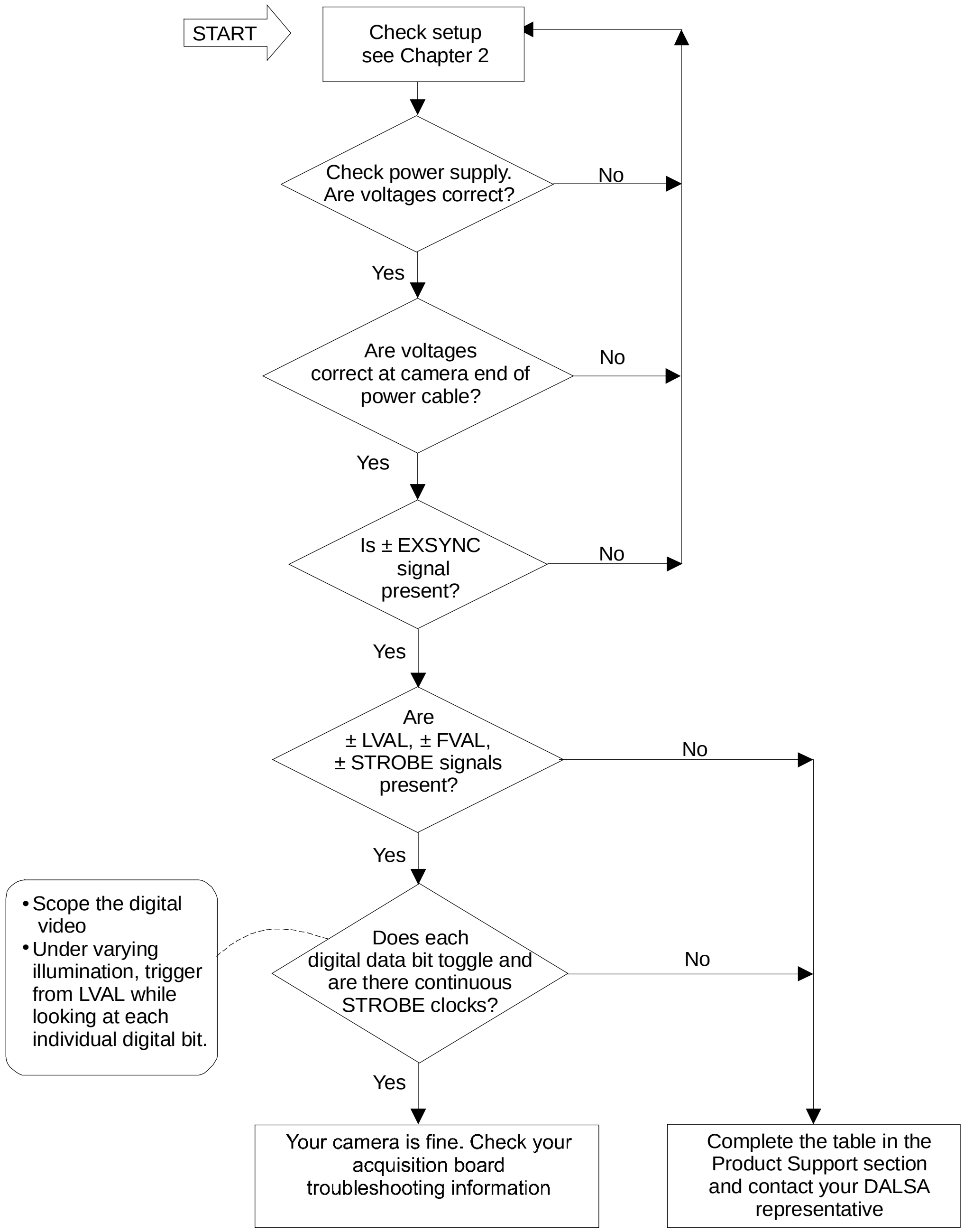
Power Supply Voltages

Check for the presence of all analog and digital voltages at the camera DB25 connector. Verify that all grounds are connected.

EXSYNC

The EXSYNC signal from your framegrabber or camera controller must either toggle or be connected to logic LOW. With EXSYNC restricted to logic HIGH, the camera will not output any data. Using an oscilloscope, check the camera end of the control signal cable and verify that EXSYNC and EXSYNCB toggle.

Figure 10. Troubleshooting Flowchart



Data Clocking/Output Signals

Verify the presence of all data clocking and output signals. Trigger the oscilloscope from the rising edge of FVAL (ch1; DC coupled). Adjust the oscilloscope time base to allow for a complete cycle of each signal:

- **STROBE**—Verify the presence of the STROBE and STROBEB signals. There should be a continuous clock signal present at the same frequency as your data rate.
- **LVAL**—Verify the presence of the LVAL and LVALB signals.
- **FVAL**—Verify the presence of the FVAL and FVALB signals.
- **Digital Output**—Use FVAL to trigger the scope sweep. Illuminate the camera target and check each individual digital output signal on ch2 of the oscilloscope (±D0 - D7 on the digital output connector). The digital output data signal should change value when light is blocked from the camera lens.

If any of the above signals are missing, contact DALSA product support.

4.2 Specific Solutions

No Output or Erratic Behavior

If your camera provides no output or behaves erratically, it may be picking up random noise from long cables acting as antennae. Do not attach wires to unused pins. Verify that the camera is not receiving spurious MCLK, or USR_EN inputs.

Noisy Output

Check your power supply voltage outputs for noise. Noise present on these lines can result in poor video quality. Low quality or non-twisted pair cable can also add noise to the video output.

Dark Patches

If dark patches appear in your output the optics path may have become contaminated. Clean your lenses and sensor windows with extreme care.

1. Take standard ESD precautions.
2. Wear latex gloves or finger cots
3. Blow off dust using a filtered blow bottle or dry, filtered compressed air.
4. Fold a piece of optical lens cleaning tissue (approx. 3" x 5") to make a square pad that is approximately one finger-width

5. Moisten the pad on one edge with 2-3 drops of clean solvent—either alcohol or acetone. Do not saturate the entire pad with solvent.

6. Wipe across the length of the window in one direction with the moistened end first, followed by the rest of the pad. The dry part of the pad should follow the moistened end. The goal is to prevent solvent from evaporating from the window surface, as this will end up leaving residue and streaking behind.

7. Repeat steps 2-4 using a clean tissue until the entire window has been cleaned.

8. Blow off any adhering fibers or particles using dry, filtered compressed air.

Stuck Bits

If data bits seem to be stuck or do not change, check that the camera is not saturated by preventing light from entering. Next, disconnect the digital cable from the camera. Check the digital signals at the output of the camera, ensuring that the correct values are present. Check all cable connections, especially right at the connector; poor connections or broken wires will cause randomly changing bits or stuck bits.

Horizontal Lines or Patterns in Image

Patterns may be caused by low frequency illumination variations. Use a DC or high frequency light source.

4.3 Product Support

If the troubleshooting flowchart indicates a problem with your camera, collect the following data about your application and situation and call your DALSA representative.

Note: You may also want to photocopy this page to fax to DALSA.

Customer name	
Organization name	
Customer phone number **fax number**	
Complete Product Model Number (e.g. CL-C3-1024A-STDJ)	
Complete Serial Number	
Your DALSA Agent or Dealer	
Acquisition System hardware (framegrabber, host computer, light sources, etc.)	
Acquisition System software (version, OS, etc.)	
Power supplies and current draw	
Data rate used	
Control signals used in your application, and their frequency or state (if applicable)	❑ EXSYNC ❑ BIN ❑ MCLK ❑ Other _______ ❑ PRIN
Detailed description of problem encountered.	*please attach description with as much detail as appropriate*

In addition to your local DALSA representative, you may need to call DALSA Technical Sales Support:

	North America	Europe	Asia
Voice:	519-886-6000	+49-8142-46770	519-886-6000
Fax:	519-886-8023	+49-8142-467746	519-886-8023

Appendix A: EIA-644 Reference

EIA-644 is an electrical specification for the transmission of digital data. The standard is available from the EIA (Electronic Industries Association). It defines voltage levels, expected transmission speeds over various cable lengths, common mode voltage operating requirements for transmitters and receivers, and input impedances and sensitivities for receivers. The table below gives a quick comparison between EIA-644 and RS422 (another differential standard).

Table 3. RS422 vs. EIA-644

Parameter	RS422	EIA-644
Differential Driver Output Voltage	±2-5V	±250-450mV
Receiver Input Threshold	±200mV	±100mV
Data Rate	<30Mbps	>400Mbps
Supply Current, Quad Driver (no load, static)*	60mA	3.0mA
Prop. Delay of Driver, max.*	11ns	3ns
Prop. Delay of Receiver, max.*	30ns	5ns
Supply Current, Quad Receiver (no load, static)*	23mA	10mA

* based on National Semiconductor DS90C031/2

The standard requires that two wires (e.g. twisted pair) be used to transmit one signal in a differential mode. This means that one wire will be logic HIGH while the other wire is logic LOW. Voltage swing between HIGH and LOW is approximately 350mV, with a typical offset of approximately 1.25V. The use of differential signal transmission allows the receiver to reject common mode voltages. This noise rejection improves data integrity and allows cameras to be installed in an industrial environment.

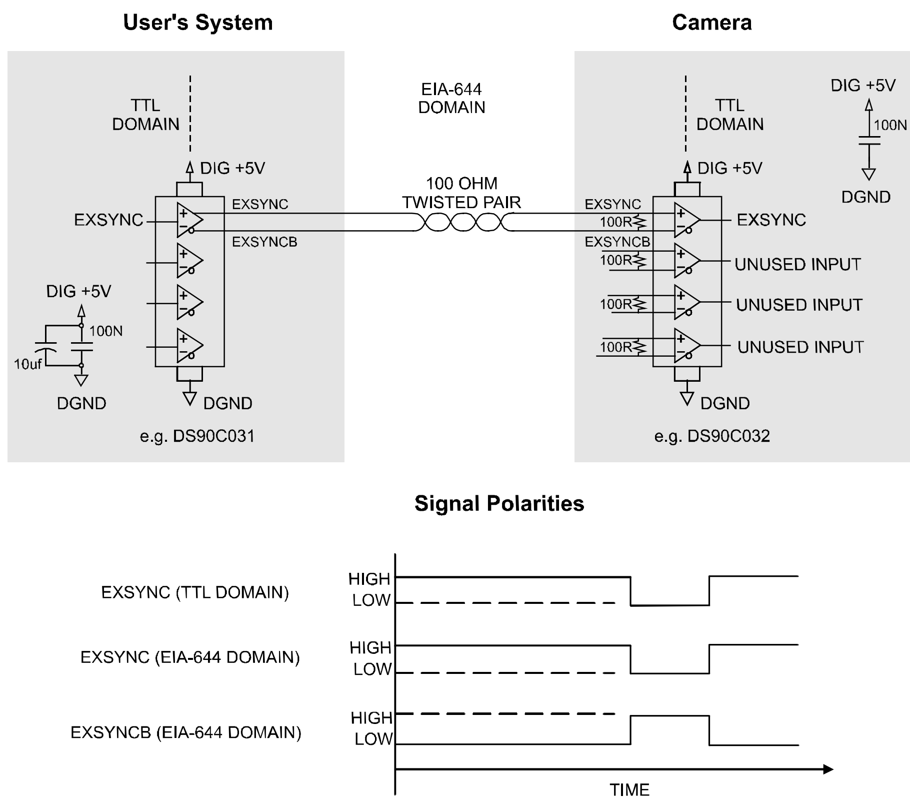
EIA-644-compatible line receivers and drivers are available from many different IC manufacturers in a variety of fabrication technologies such as CMOS and GaAs. The EIA-644 standard does not define specific voltages, so it can migrate from 5V power supplies to 3.3V and sub-3V. DALSA recommends the use of 5V CMOS line drivers and receivers such as National Semiconductor parts DS90C0C31 quad line driver and DS90C032 quad line receiver.

To achieve full benefit of the common mode rejection, twisted pair cable should be used for all EIA-644 signals. The cable impedance should be 100 Ohms and the cable terminated at the receiving end with a 100 Ohm resistor. All EIA-644 inputs

in a DALSA camera are terminated with 100 Ohms between the (+) and (-) of a signal. Figure A-1 (a) shows an example of an EIA-644 transmission.

DALSA indicates the (+) signal by the name of the signal; i.e. MCLK, while the (-) signal is indicated by either an overscore over the name or appending the letter B to the end of the name; i.e. $\overline{\text{MCLK}}$ or MCLKB. The (+) signal has the same sense as the TTL signal which is sent or received; i.e. when MCLK in the TTL domain is HIGH then MCLK in the EIA-644 domain is HIGH. The (-) signal has the opposite sense of the TTL domain signal and so if MCLK TTL is HIGH then MCLKB EIA-644 is LOW. Figure 11 shows the relationship.

Figure 11. EIA-644 Example



Unused EIA-644 Inputs and Outputs

Unused **outputs** should be left unconnected. This will reduce power dissipation within the camera and reduce radiated emissions.

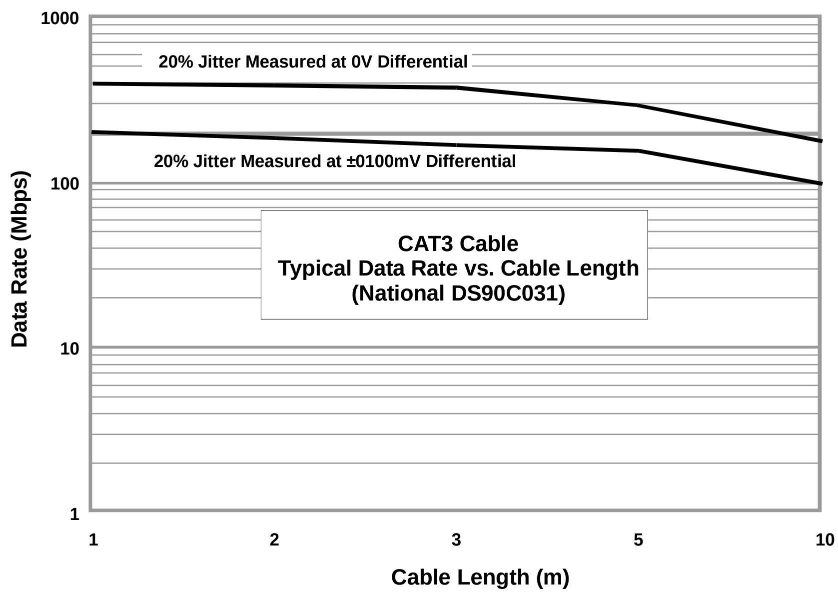
Unused **inputs** should also be left unconnected; EIA-644 chips have fail-safe features that guarantee a known logic state (HIGH) in fault conditions

(unconnected, shorted, or unterminated). **Do not connect cables to unused inputs.** Cables can act as antennae and cause erratic camera behavior.

Cable Lengths

Figure 12 shows a graph of ideal communication data rate vs. cable length for the EIA-644 standard.

Figure 12. EIA-644 Data Rate vs. Cable Length



CA-D6-xxxxW User's Manual

Appendix B: EMC Declaration of Conformity

We, **DALSA INC.**
605 McMurray Rd., Waterloo, ON
CANADA N2V 2E9

declare under sole responsibility, that the product(s):

CA-D6-0256W-ECEW
CA-D6-0512W-ECEW

meets the test (limits) for:

Electrostatic Discharge, IEC 1000-4-2; 1995
Radiated Immunity, IEC 1000-4-3; 1995
Burst ELF, Class III, IEC 1000-4-4; 1995
Radiated Emissions, CISPR 22

and therefore correspond(s) to the regulations of the EU-Directive 89/336/EEC.

Place of Issue	**Waterloo, ON, CANADA**
Date of Issue	**18 November 1997**
Name and Signature of authorized person	**Brian Doody** **Vice-President, Operations**

This Declaration corresponds to EN 45 014.

Index

1

A

B

C

D

E

F

H

I

L

M

N

O

P

R

S

T

U